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# Criticality Safety Controls and Disposal of TRU Drums Generated by LLNL Pu Facility

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## Disclaimer

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**Introduction**

The Pu Facility (PF) at LLNL involves research and development of nuclear material technologies and their applications. The wastes produced may be contaminated with TRU isotopes. This paper describes TRU drum criticality safety controls in the LLNL PF and their disposal at the WIPP (Waste Isolation Pilot Plant).

**LLNL PF TRU Drum Controls**

In the PF, criticality safety controls are applied through the use of standard criticality control conditions (SCCCs). Three of the SCCCs, namely, A, W, and Wx, are applied to 55-gallon Type A TRU drums as criticality safety controls. Criticality safety controls for three SCCCs are shown in Table 1.

Table 1. LLNL Pu Facility TRU Drum controls for SCCCs A, W, and Wx

| SCCC | A | W | Wx |
|---|---|---|---|
| Fissile Loadings (g) | 65 | 120 | 200 |
| Hydrogenous Materials | unlimited (HDPE) | PE | PE |
| Superior Moderator/ Reflector | unlimited | 100 kg U or 300 g Be or 8 kg graphite | 50 grams |

SCCC W was first developed in 1980's based on the historical TRU contents for drums produced at LLNL. SCCC A was originally developed in late 1990's to accommodate drums not meeting the SCCC W requirements. SCCC Wx was derived in early 2000's to facilitate the offsite disposal of TRU drums based on the WIPP 200 gram limit.

These controls are derived using the very conservative assumptions listed below:

1. The fissile materials in each drum are optimally moderated by polyethylene (PE) as a spherical core. The core is first reflected by allowed reflectors in shells and then by the bulk PE inside the drum.
2. The fissile cores are then placed in a closest configuration in a 2-wide and 2-high 4-drum formation in infinite X-Y array.
3. SCCCs W and Wx drum arrays are no less than 6-high and SCCC A arrays are two-high.

These criticality safety controls ensure that the TRU drums can be safely stored and handled in the PF.

Most of the PF TRU drums are generated in SCCC W. SCCCs Wx and A are applied only when TRU drums cannot be placed in SCCC W.

**Fissile Drum Loading Verification and Acceptance**

Waste information is collected on the TRU waste parcel card and the Waste Disposal Requisition. Radionuclide activity, contained moderators and reflectors, dose rates are collected along with other pertinent information. These documents are reviewed by the waste technician, a Radiological Characterization Analyst (RCA), and a Characterization Chemist. The record is then submitted to the Records Control Office (RCO) for final review and approval for acceptance into the LLNL waste storage facility. A review for conformance with criticality safety criteria is conducted by the RCA and by the RCO. The drums typically are "W" drums but occasionally "Wx" drums may be accepted with approval by the Storage and Disposal (S&D) Group Leader approval. If the criticality safety criteria are not met, then a Criticality Safety Administrative Memorandum (CSAM) is requested from the Nuclear Criticality Safety Division for the specific drum. Once the CSAM is submitted, the RCO and the S&D Group will accept the drum provided it meets their facility waste acceptance criteria.

**PF TRU Drum Disposal**

Disposal of PF TRU drums at WIPP is through the RHWM (Radioactive and Hazardous Waste Management). TRU drums, when meeting the WIPP waste acceptance criteria (WAC) [1], are accepted into the RHWM storage facilities first prior to shipment to WIPP. It should be noted that LLNL drum loadings do not factor in the uncertainties in the measurements. WIPP WAC requires the drum loadings be the measured values plus two times the uncertainty in standard deviations from radioassays.

SCCC W drums can easily meet the WIPP drum loading requirements, even with the addition of 2 standard deviations of the measurement uncertainty. For instance, a drum loading of 120 grams Pu with 2 times of a 30% uncertainty results in 192 grams Pu, which is still meet 200 fissile gram equivalent (FGE) [1] as allowed by WIPP WAC. With beryllium, the TRUPACK-II loading limits [1.2] is decreased from 325 to 100 grams with Type A drums when the Be content exceeds 1%. SCCC W drums are allowed 300 grams Be each. There is no more than 1% beryllium in SCCC W drums when their contents exceed 30 kg. Therefore, SCCC W drums can be shipped in TRUPACK-II with the WIPP 325-gram limit. As for SCCCs Wx and A drums, they will require repackaging if not able to meet the WIPP WAC. However, there are limited repackaging capabilities at LLNL at the present moment. There will be a delay in having these drums repackaged.

The Plutonium Facility typically generates 80 TRU drums per year. When the LLNL De-Inventory Program started in 2007, TRU drum generation rates increased to 100+ annually and is projected to stay at that rate through 2012. In the 2005 TRU Waste campaign, 680+ drums were shipped to WIPP. Another 200 were shipped to Idaho for WIPP certification and disposal in 2010. Of the 900+ drums shipped offsite, 800+ were originated from the PF and the rest from other facilities, such as, B251, which is in maintenance mode pending final D&D. Following the 2010 shipping campaign to Idaho, approximately 600 TRU drum will remain at LLNL. These drums were mostly rejected for WIPP for reasons not related to the fissionable material loading, such as containing prohibited items (un-punctured cans, sealed containers greater than 4 liters, etc) and/or not meeting the Contact Handled TRU Waste Packaging requirements issued by DOE Head Quarters in FY2009.

**Conclusions**

LLNL PF TRU drums are controlled by SCCCs A, W, and Wx. Most of TRU drums at LLNL are under SCCC W. SCCC W drums can easily meet the WIPP waste acceptance criteria. Almost 900 TRU drums have been shipped offsite for final disposal at WIPP.

**References:**


1. WIPP WAC, DOE/WIPP-02-2122, Revision 6.4, US DOE Carlsbad Field Office, December 2009.
2. TRUPACK-II Certification of Compliance


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